AsFiled
P-4581

EXPRESS MAIL LABEL NO:
EL579667004US

METHOD AND SYSTEM FOR INSERTING A DATA OBJECT INTO A COMPUTER-GENERATED DOCUMENT USING A TEXT INSTRUCTION

Thomas Lange

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates generally to generating documents using a computer application, and in particular to inserting a data object like a mathematical formula or special characters like Greek characters into a computer-generated document as for example a text document.

Description of Related Art

Computer word processing applications typically are used to generate a document, referred to as a computer-generated document, that may contain text data, tables, diagrams, etc. and often mathematical formulae or special characters like Greek characters. Mathematical formulae and special characters are particularly important for documents like scientific articles and the like. Similarly, HTML Web page generators generate a document that is effectively a text-based document.

For creating a mathematical formula within a text document 100 (Fig. 1), so called formula editors were used. Typically, the formula editor was opened from within the computer word processing application by clicking on a menu bar icon, or alternatively using a menu.

The formula editor contained a large number of displayed key fields and list boxes representing different elements of mathematical formulae like brackets, integrals, fraction bars, matrices, so forth. For inserting special characters, like for example the Greek character Σ, it was necessary to enter a list box containing the special characters.

The user created the desired formula 101 using these keys and list boxes. After having completed the formula, the user returned to the original document and pasted the formula as an imported object into the document. If the user recognized an error in the formula, the user again opened the formula editor, corrected the error, and returned to the original document.

Using a formula editor, it was possible to create nearly every desired mathematical formula; however, the operation was complicated and time consuming in particular for simple formulae like simple fractions or square roots, which appeared frequently in a text document. Editing of the formula always required entering the formula editor and subsequently returning into the original document.

To simplify the entry of formulas, some formula editors permitted the use of script like phrases that the formula editor converted to the corresponding mathematical expression. However, while this assisted in entering a formula in some situations by minimizing the use of key fields and list boxes, the general problem of having to utilize the formula editor persisted.

Sub A1 In an attempt to minimize some of the entry and exit issues, it was known to select an insert option from a menu bar of an application and the formula editor capability was opened so that the user and

insert could edit a formula without leaving the application, only the menus and the object bars were changed. After the formula editor capability was used to enter the data object, double clicking on the embedded object launched the formula editor capability so that the formula could be edited. Again, this was done without leaving the application.

SUMMARY OF THE INVENTION

According to the principles of this invention, inserting or editing a data object like a mathematical formula or special character in a computer-generated document is facilitated and sped up in comparison to the prior art methods that required use of a formula editor. A method of inserting a data object into a computer-generated document includes inputting instruction symbols representing the data object into the document in the form of text characters, selecting the document portion containing instruction symbols, and converting the instruction symbols contained in the selected document portion into a data object represented by the instruction symbols.

With the present invention it is possible to input the data object, which may be a mathematical formula or a Greek, Chinese, Korean, Cyrillic, Arabic, Hebrew, or Japanese character, or any other character or symbol, and which can be represented by certain instruction symbols, into the document using standard characters, which are also used for creating a text document. The user does not need to leave the document and can input the instruction symbols in the same way as the text characters, for example by typing on a keyboard.

If the selected document portion contains characters, which are not part of an instruction these characters remain unchanged during the converting

operation. Those unchanged characters may be variables like a, b, or x in a mathematical formula.

In one embodiment, the converted data object is inserted into the document at the position of the selected document portion. The inserted data object is formatted depending on a surrounding content, for example, the same as the format of text in the same line. The inserted data object is automatically stored with the document in this embodiment. The inserted data object is reconvertible into the original document portion for editing purposes.

The document portion including the instruction symbols may be input by means of speech decoding. In this case, the present invention is particularly advantageous since the instruction symbols (in contrast to the mathematical symbol itself) may be expressed orally.

One embodiment of the invention allows fast and easy generation and editing of a data object like a mathematical formula or special characters. This is particularly useful for simple and short data objects and for data objects, which the user needs frequently and for which the user easily memorizes the instruction symbols representing these data objects. For inserting the object, the user needs not to enter a special tool like a formula editor and then return to the original document. Another advantage of the present invention is that it allows the input of the data objects by speech decoding since the instruction symbols can be expressed orally.

Another embodiment of the invention provides a computer program for inserting, on a computer, a data object into a document, comprising inserting instruction symbols representing the data object in the form of text characters into the document, selecting a

document portion containing instruction symbols, and converting the instruction symbols contained in the selected document portion into the data object represented by the instruction symbols.

Program code may be embodied in any form of a computer program product. A computer program product comprises a medium configured to store or transport computer readable code, or in which computer readable code may be embedded. Some example of computer program products are CD-ROM discs, ROM cards, floppy discs, magnetic tapes, computer hard drives, servers on a network and signals transmitted over a network representing computer readable program code.

According to a still further embodiment, the present invention provides a software tool providing instructions for inserting a data object into a computer-generated document by inserting instruction symbols inputted in the form of text characters and representing the data object into the document, converting instruction symbols contained in a selected document portion into the data object represented by the instruction symbols, inserting the converted data object into the document, and providing signals for displaying the document including the converted data object.

According to another embodiment, the present invention provides a computer-generated document including a data object generated by a conversion of instruction symbols inputted in the form of text characters, wherein the data object is reconvertible into the instruction symbols.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a schematic representation of a prior art document containing a mathematical formula.

Figure 2A is an example of a text document containing instruction symbols representing a data object according to the present invention.

Figure 2B is a schematic representation of the text document shown in Figure 2A after conversion of a data object.

Figure 2C is a process flow diagram for the method of the present invention.

Figure 3A is a schematic illustration of a computer system to which the present invention may be applied.

Figure 3B is a schematic illustration of a client-server computer system in which the present invention may be transferred and/or downloaded.

DETAILED DESCRIPTION

According to the principles of this invention, a user enters a formula in a computer-generated document by simply typing in text representing the formula and selecting this text. In response to the selection of the text representing the formula, the text representing the formula is automatically converted to a mathematical formula and inserted in the computer-generated document as a data object.

Consequently, with this invention, a user generating a document on a computer no longer has to continually open a formula editor to enter a formula. Rather, the user simply continues to input text information in the same form as the rest of the document including text that describes the formula. Similarly, a user can type in text representing a special character, e.g., a Greek, Chinese, Korean, Cyrillic, Arabic, Hebrew, or Japanese character, or any other character or symbol, and use the method of this invention to automatically convert the text

representing the special character to a data object that is inserted in the computer-generated document.

According to the principles of this invention, in a text-based formula generation method 205, a user inputs text in an input text operation 221 (Fig. 2C) into a computer-generated document 200A (Fig. 2A), which is displayed on a display screen 210 by an application 319 (Fig. 3A) executing on a computer processor 312C. In operation 221, (Fig. 2C) the user inputs the text using, for example, a keyboard in input units 320C (Fig. 3A) of a computer system 300C, which is representative of a computer system input device. The text, however, can be input using another suitable input technique and/or input device, e.g. voice recognition processing or the like.

Input text operation 221 transfers to formula check operation 222. If the user does not want to input a formula, formula check operation 222 returns to input text operation 221. Conversely, if the user wants to input a formula into document 200A, formula check operation 222, which is carried out by the user, transfers to input instruction operation 223.

In input instruction operation 223, the user inputs the formula using text instruction symbols via one of input units 320C. For example, as illustrated in Figure 2A, the user inputs the text portion "x equal sqrt a over b", which includes the text instruction symbols, equal, sqrt, and over. The user is not required to change modes of input, and is not required to access a formula editor and type the formula into the editor, but rather the user simply continues inputting characters in a conventional fashion.

After completing the text input for the desired formula in input instruction operation 223, the user selects the text formula instruction in select

instruction 224. In this embodiment, the user first highlights text formula instruction 212 and then moves cursor 211 to an equation icon 213. With cursor 211 on equation icon 213 and with text formula instruction 212 highlighted, the user clicks a mouse button to complete select instruction operation 224. In more general terms, select instruction operation 224 identifies a text formula instruction 212 for a generate formula method 230. Operations 221 to 224 form a text formula instruction generation and identification method 220.

In generate formula method 230, formula check operation 231 determines whether the user selected a text formula instruction. In this embodiment, check operation 231 determines whether the user clicked on equation icon 213. If the user selected a text formula instruction, check operation 231 transfers to convert instruction operation 233 and otherwise to continue operation 232. In one embodiment, check operation 231 is part of an event handler of application 319, and if the event is not a text formula instruction selection input, event handling continues in continue operation 232 and the application continues as in the prior art.

However, if a text formula instruction selection input event occurred, processing transfers to convert instruction operation 233. Convert instruction operation 233 cuts the selected text formula instruction and pastes the selected text formula instruction into a call to a formula editor that can process the text formula instruction. For example, a prior art formula editor is modified to receive a text formula instruction and output a data object that is a corresponding formula. The modified formula editor executes in the background and the user is unaware of its existence. Upon the modified formula editor

returning a data object, which in this example is a mathematical formula

$$x = \sqrt{\frac{a}{b}}\,.,$$

combinations of characters in the text formula instruction, which do not represent text instruction symbols, like the variables x, a and b in this example, remain unchanged. Hence, the creation of a formula containing variables is possible. Upon return of the mathematical formula, i.e., the data object, processing transfers from convert instruction operation 233 to insert formula operation 234.

In insert formula operation 234, the data object, i.e., formula 214, is inserted in document 200B at the location from which the text formula instruction sequence was cut, and is displayed on display unit 210. Preferably, the formula is formatted like the surrounding text so that the visual appearance of text document 200B containing the formula is optimized. However, in one embodiment, the user can include text instructions to format any part, or all of the formula in a specific format, which may be different from the format of the surrounding text.

Following insert formula operation 234, document complete check operation 235 determines whether the user has entered an instruction to indicate the document is complete. If a document complete instruction has been issued, the finished document is saved. Preferably, the inserted data object is stored together with the text document in a memory, e.g., memory 311B, which is this case is located in a file server 300B. If the document is not complete, check operation 235 returns to input text operation 221.

Those of skill in the art will appreciate that the method of this invention can be multithreaded. For example, one thread permits the user to continue entering additional text, while another thread executes the text formula instruction. Also, as illustrated in Figures 2A and 2B, the content of a text document 200A, may include in addition to the text data also other data like diagrams, graphics or tables. The text document also may be, for example, an HTML- or XML-document. In addition, the present invention is not restricted to text documents.

Hence, according to the principles of this invention, if a user wishes to input a special data object like a formula into the text document, the user enters the formula in the form of a text formula instruction that includes text instruction symbols and variables. For example, the formula

$$\frac{a}{b}$$

is represented by "a over b". Here, the characters "a" and "b" represent variables and "over" is a text instruction symbol representing a fraction bar. Other examples of text formula instructions are "sqrt a" for $\sqrt{a}$, "3 ind 1" for 3_1 and "int (a,b) Omega dt" for

$$\int_a^b \Omega dt \ .$$

From the last example, it is obvious that the present invention is also very useful for inserting special characters like Greek characters into a text document. "pi" may represent the Greek character π, "alpha" may represent α or "lambda" may represent λ. It is also

possible to distinguish between small and capital letters, "Lambda" may for example represent Λ. It is immediately apparent that typing the instruction symbols is in many cases much easier and faster than using a special program like a formula editor or a list box for Greek symbols. The same can apply to other special characters like Chinese, Korean, Cyrillic, Arabic, Hebrew, or Japanese characters, or any other character or symbol characters. In another embodiment, a character, e.g., a percent sign, is used before the name of the character to assist in distinguishing between when the user wants the text word, and when the user wants the Greek or other symbol.

Table 1 lists a number of different formula symbols that can be generated in using a text formula instruction. Notice that in each instance, the text formula instruction utilizes only characters that are found on a conventional computer keyboard. The last column in a row of Table 1 gives a simple example of a text instruction for a formula that utilizes the symbol presented in the first column of the row. In the last column, a, b, x, y, and z are used as variables. The text instruction symbol is in a bold font.

TABLE 1

Symbol Presented in Formula	Type	Description	Example of text formula instruction
+	Unary operator	Plus Sign	+a
-	Unary operator	Minus Sign	-a
±	Unary	Plus Minus Sign	**plusminus** a

Symbol Presented in Formula	Type	Description	Example of text formula instruction
	operator		
∓	Unary operator	Minus Plus Sign	**minusplus** a
¬	Unary operator	Logical negation	**neg** a
|❑|	Unary operator/ function	Absolute value	**abs** a
!	Unary operator/ function	Factorial	**fact** a
√	Unary operator/ function	Square root	**sqrt** a
$\sqrt[n]{}$	Unary operator/ function	n-th root	**nroot** n a -- where n is the desired nth root of a
	Unary operator	User-defined operator	**uoper** %theta x
=	Binary operator/ relation	Equal	a = b
≠	Binary operator/ relation	Not equal	a **neq** b, or a **<>** b
+	Binary operator	Addition	a + b
⊕	Binary operator	Add symbol in circle	a **oplus** b
-	Binary	Substraction	a - b

Symbol Presented in Formula	Type	Description	Example of text formula instruction
	operator		
⊖	Binary operator	Subtract symbol in circle	a **ominus** b
*	Binary operator	Multiply	a * b
•	Binary operator	Dot product	a **cdot** b
⊙	Binary operator	Dot product in a circle	a **odot** b
×	Binary operator	Multiplication	a **times** b
⊗	Binary operator	Multiply symbol in circle	a **otimes** b
/	Binary operator	Division	a / b
/	Binary operator	Slash for quotient set between two characters	a **slash** b **slash** c
□/□	Binary operator	Slash between two characters, of which the left character is superscript, and the right is subsript	a **wideslash** b
□\□	Binary operator	Back Slash between two characters, of which the right character is	a **widebslash** b

Symbol Presented in Formula	Type	Description	Example of text formula instruction
		superscript, and the left subscript	
⊘	Binary operator	Slash in circle	a **odivide** b
÷	Binary operator	Division	a **div** b
$\frac{a}{b}$	Binary operator	Division/ Fraction	a **over** b
∧	Binary operator	Logical AND	a **and** b, or a & b
∨	Binary operator	Logical Or	a **or** b, or a | b
∘	Binary operator	Concatenate	a **circ** b
|	Binary operator	Divides	5 **divides** 30
∤	Binary operator	Does not Divide	7 **ndivides** 30
>	Binary operator / Relation	Greater than	a **gt** b, or a > b
<	Binary operator / Relation	Less than	a **le** b, or a < b
≥	Binary operator / Relation	Greater than or equal to	a **gt** b, or a >= b
⩾	Binary operator / Relation	Greater than-equal to	a **gtslant** b

Symbol Presented in Formula	Type	Description	Example of text formula instruction
≫	Binary operator / Relation	Much greater than	a **gg** b, or a >> b
≤	Binary operator / Relation	Less than or equal to	a **le** b, or a <= b
⩽	Binary operator / Relation	Less than-equal to	a **leslant** b
≪	Binary operator / Relation	Much less than	a **ll** b, or a << b
$\stackrel{\text{def}}{=}$	Binary operator / Relation	Is defined as/ by definition equal to	a **def** b
≡	Binary operator / Relation	Is equivalent/ congruent to	a **equiv** b
≈	Binary operator / Relation	Is approximately	a **approx** b
~	Binary operator / Relation	Is similar to	a **sim** b
≃	Binary operator / Relation	Is similar or equal to	a **simeq** b
∝	Binary operator / Relation	Is proportional to	a **prop** b
⊥	Binary	Is orthogonal	a **ortho** b

Symbol Presented in Formula	Type	Description	Example of text formula instruction
	operator / Relation	to	
∥	Binary operator / Relation	Is parallel to	a **parallel** b
⊷	Binary operator / Relation	Correspondence symbol image of	a **transl** b
⊶	Binary operator / Relation	Correspondence symbol original of	a **transr** b
∈	Binary operator / Set operator	Is contained in	a **in** b
∉	Binary operator / Set operator	Is not contained in	a **notin** b
⊂	Binary operator / Set operator	Subset	a **subset** b
⊆	Binary operator / Set operator	Subset or equal to	a **subseteq** b
⊄	Binary operator / Set operator	Not subset to	a **nsubset** b
⊈	Binary operator / Set operator	Not subset or equal to	a **nsubseteq** b
⊃	Binary operator /	Superset	a **supset** b

Symbol Presented in Formula	Type	Description	Example of text formula instruction
	Set operator		
⊇	Binary operator / Set operator	Superset or equal to	a **supseteq** b
⊅	Binary operator / Set operator	Not superset to	a **nsupset** b
⊉	Binary operator / Set operator	Not superset or equal to	a **nsupseteq** b
∋	Binary operator / Set operator	Contains	a **owns** b, or a **ni** b
∪	Binary operator / Set operator	Union of Sets	a **union** b
∩	Binary operator / Set operator	Intersection of Sets	a **intersection** b
\	Binary operator / Set operator	Difference between Sets	a **setminus** b, or a **bslash** b
x_n	Binary operator	x with index n	x **sub** n
x^n	Binary operator	n-th power of x	x **sup** n
→	Binary operator / Relation	Toward	a **toward** b
	Binary opeator	User defined binary operator	x **boper** %theta y --used to

Symbol Presented in Formula	Type	Description	Example of text formula instruction
			insert greek character theta
Σ	Operator	Sum	**Sum** x **sub** i
Π	Operator	Product	**prod** x **sub** i
$\amalg$	Operator	Coproduct	**coprod** x **sub** I
lim	Operator	Limit	**lim** x **toward infinity**
lim inf	Operator	Limit inferior	**liminf**
lim sup	Operator	Limit superior	**limsup**
$\hbar$	Operator/ Physics	Physics Constant	**hbar**
λ	Operator/ Physics	Physics Constant	**lambdabar**
$\exists$	Operator/ Logic	Existential quantifier, there is at least one	a **exists** b
$\forall$	Operator/ Logic	Universal quantifier, for all	a **forall** b
$\Leftarrow$	Operator/ Logic	Arrow with double line to the left	a **dlarrow** b
$\Rightarrow$	Operator/ Logic	Arrow with double line to the right	a **drarrow** b
$\Leftrightarrow$	Operator/ Logic	Arrow with double line to the left and to the right	a **dlrarrow** b

Symbol Presented in Formula	Type	Description	Example of text formula instruction
$\uparrow$	Operator	Up arrow	a **uparrow** b
$\downarrow$	Operator	Down arrow	a **downarrow** b
$\leftarrow$	Operator	Left arrow	a **leftarrow** b
$\rightarrow$	Operator	Right arrow	a **rightarrow** b
$\int$	Operator	Integral	**in** xdx
$\iint$	Operator	Double Integral	**iint** f(x,y)dxdy
$\iiint$	Operator	Triple Integral	**iiint** f(x,y,z)dxdydz
$\oint$	Operator	Curve integral	**lint**
$\oiint$	Operator	Double curve integral	**llint**
$\oiiint$	Operator	Triple curve integral	**lllint**
	Operator	User defined operator	**oper** %union **from** {i=1} **to** n x_{i}
	Operator	Range from . . . to	**from** {i=1} **to** n
	Operator	Lower limit of an operator	**from** {i=1}
	Operator	Upper limit of an operator	**to** n
sin()	Function	Sine	**sin** x
cos()	Function	Cosine	**cos** x
tan()	Function	Tangent	**tan** x
cot()	Function	Cotangent	**cot** x
arcsin()	Function	Arcsine	**arcsin** x
arccos()	Function	Arccosine	**arccos** x
arctan()	Function	Arctangent	**arctan** x

Symbol Presented in Formula	Type	Description	Example of text formula instruction
arccot()	Function	Arccotangent	**arccot** x
sinh()	Function	Hyperbolic sine	**sinh** x
cosh()	Function	Hyperbolic cosine	**cosh** x
tanh()	Function	Hyperbolic tanget	**tanh** x
coth()	Function	Hyperbolic cotangent	**coth** x
arsinh()	Function	Area hyperbolic sine	**arsinh** x
arcosh()	Function	Area hyperbolic cosine	**arcosh** x
artanh()	Function	Area hyperbolic tanget	**artanh** x
arcoth()	Function	Area hyperbolic cotangent	**arcoth** x
exp()	Function	General exponential function	**exp** x
ln	Function	Natural logarithm	**ln** x
log	Function	Logarithm base 10	**log** x
e□	Function	Natural exponential function	**func** e^{x}
IN	Mathematical symbol	Natural number	**setn** a
ℤ	Mathematical symbol	Integer	**setz** a
ℚ	Mathematical	Rational number	**setq** a

Symbol Presented in Formula	Type	Description	Example of text formula instruction
	symbol		
$\mathbb{R}$	Mathematical symbol	Real number	**setr** a
$\mathbb{C}$	Mathematical symbol	Complex number	**setc** a
$\aleph$	Mathematical symbol	Cardinal number	**aleph** a
$\ni$	Mathematical symbol	back epsilon	**backepsilon**
$\varnothing$	Mathematical symbol	Empty set	**emptyset**
$\Re$	Mathematical symbol	Real part of a complex number	**re** a
$\Im$	Mathematical symbol	Imaginary part of a complex number	**im** a
∞	Mathematical symbol	Infinity	**infinity**, or **infty**
∇	Mathematical symbol	Nabla vector	**nabla** x
∂	Mathematical symbol	Partial differentiation or set margin	**partial** x
$\wp$	Mathematical symbol	p function	**wp**
⋯	Other symbol	Three dots vertically in the symbol center	**dotsaxis**
⋰	Other symbol	Three dots	**dotsup**,

Symbol Presented in Formula	Type	Description	Example of text formula instruction
		diagonally from lower left to upper right	or **dotsdiag**
⋱	Other symbol	Three dots diagonally from upper right to lower left	**dotsdown**
...	Other symbol	Three dots horizontally below	**dotslow**
⋮	Other symbol	Three dots vertical	**dotsvert**
□	Other symbol	Placeholder	<?>
()	Bracket with grouping function	Normal round left and right brackets	(a **over** b) **oplus** c
[]	Bracket with grouping function	Normal left and right square brackets	[a **over** b] **oplus** c
⟦⟧	Bracket with grouping function	Left and right double square brackets	**ldbracket** . . . **rdbracket**
{}	Bracket with grouping function	Left and right curly brackets, set bracket	**lbrace** . . . **rbrace**
⏞	Bracket with grouping function	Scalable curly set bracket on top	. . . **overbrace** . . .
⏟	Bracket with grouping function	Scalable curly set bracket below	. . . **underbrace** . . .

Symbol Presented in Formula	Type	Description	Example of text formula instruction
<>	Bracket with grouping function	Left and right pointed brackets	**langle . . . rangle**
< | >	Bracket with grouping function	Left and right pointed operator brackets	**langle . . . mline . . . rangle**
< | >	Bracket with grouping function	Scalable left and right pointed operator brackets	**left langle . . . mline . . . right rangle**
| |	Bracket with grouping function	Left and right vertical lines	**lline . . . rline**
|| ||	Bracket with grouping function	Left and right double lines	**ldline . . . rdline**
⌊ ⌋	Bracket with grouping function	Left and right lines with lower edges	**lfloor . . . rfloor**
⌈ ⌉	Bracket with grouping function	Left and right lines with upper edges	**lceil . . . rceil**
	Bracket with grouping function	Automatic sizing of brackets by putting left and right (left . . . right . . .) up front,	

Symbol Presented in Formula	Type	Description	Example of text formula instruction
		e.g., left(a over b right) or left lceil . . . right lceil. This way round, square, double square, single, double, single, curley, pointed, and operator brackets can be changed.	
(	Bracket, also widowed, without grouping function	round left bracket	\(
)	Bracket, also widowed, without grouping function	Normal round right bracket	\)
[	Bracket, also widowed, without grouping	Normal left square bracket	\[

Symbol Presented in Formula	Type	Description	Example of text formula instruction
	function		
]	Bracket, also widowed, without grouping function	Normal right square bracket	**\]**
{	Bracket, also widowed, without grouping function	Left curly bracket	**\lbrace**, or, \{
}	Bracket, also widowed, without grouping function	Right curly bracket	**\rbrace**, or, \}
<	Bracket, also widowed, without grouping function	Left pointed bracket	**\langle**
>	Bracket, also widowed, without grouping function	Right pointed brackets	**\rangle**

Symbol Presented in Formula	Type	Description	Example of text formula instruction
|...	Bracket, also widowed, without grouping function	Left vertical line	**\lline**
...|	Bracket, also widowed, without grouping function	Right vertical line	**\rline**
||...	Bracket, also widowed, without grouping function	Left double line	**\ldline**
...||	Bracket, also widowed, without grouping function	Right double lines	**\rdline**
⌊	Bracket, also widowed, without grouping function	Left line with lower edge	**\lfloor**
⌋	Bracket,	Right line with	**\rfloor**

Symbol Presented in Formula	Type	Description	Example of text formula instruction
	also widowed, without grouping function	lower edge	
⌈	Bracket, also widowed, without grouping function	Left line with upper edge	**\lceil**
⌉	Bracket, also widowed, without grouping function	Right line with upper edge	**\rceil**
□□	Indexes and exponents(sub-and superscript)	Right index	_, or **sub**, or **rsub**
□□	Indexes and exponents(sub-and superscript)	Right exponent	^, or **sup**, or **rsup**
□□	Indexes and exponents(sub-and superscript)	Left index	**lsub**
□□	Indexes and exponents(su	Left exponent	**lsup**

Symbol Presented in Formula	Type	Description	Example of text formula instruction
	b-and superscript)		
□ □	Indexes and exponents(sub-and superscript)	Exponent directly above a character	**csup**
□ □	Indexes and exponents(sub-and superscript)	Index directly below a character	**csub**
	Formatting	Horizontal alignment--left, center, right	**alignl**, or **alignc**, or **alignr**
	Formatting	Space/Blank	~
	Formatting	Small space/ small blank	`
	Formatting	Newline	**newline**
□ □	Formatting	Binom	**binom**
□ □ □	Formatting	Stack	**stack**{x#y#z}
□ □ □ □	Formatting	Matrix	**matrix**{a#b##c#d}
,	Attribute with fixed character width	Accent to the right above a character	**acute** a
-	Attribute with fixed	Horizontal bar above a	**bar** a

Symbol Presented in Formula	Type	Description	Example of text formula instruction
	character width	character	
˘	Attribute with fixed character width	Upside down roof above a character	**breve** a
ˇ	Attribute with fixed character width	Upside down roof	**check**
°	Attribute with fixed character width	Circle above a character	**circle** a
˙	Attribute with fixed character width	Dot above a character	**dot** a
¨	Attribute with fixed character width	Two dots above a character	**ddot** a
⃛	Attribute with fixed character width	Three dots above a character	**dddot** a
‘	Attribute with fixed character width	Accent to the left above a character	**grave** a
^	Attribute	Roof above a	**hat** a

Symbol Presented in Formula	Type	Description	Example of text formula instruction
	with fixed character width	character	
~	Attribute with fixed character width	Tilde above a character	**tilde** a
→	Attribute with fixed character width	Vector arrow above a character	**vec** a
a̲	Attribute with variable character width	Horizontal bar below a character	**underline** a
a̅	Attribute with variable character width	Horizontal bar above a character	**overline** a
a̶	Attribute with variable character width	Horizontal bar through a character	**overstrike** a
→	Attribute with variable character width	Wide vector arrow, adjusts to the character size	**widevec** a

Symbol Presented in Formula	Type	Description	Example of text formula instruction
~	Attribute with variable character width	Wide tilde, adjusts to the character size	**widetilde**
^	Attribute with variable character width	Wide roof, adjusts to the character size	**widehat**
	Font attributes	Italics	**ital**
	Font attributes	Remove italics	**nitalic**
	Font attributes	Bold	**bold**
	Font attributes	Remove bold	**nbold**
	Font attributes	Phantom character	**phantom**
	Font attributes	Command to change characters; first the font name (sans, serif, or fixed) is entered, then the characters to be changed are entered.	**font sans** a

Symbol Presented in Formula	Type	Description	Example of text formula instruction
	Font attributes	Command to change the font size; first the size is entered, then the characters to be changed are entered; for the entered sizes arguments following the pattern n, +n, -n *n or /n can be indicated; size +n and -n are changed in points(pt); a percentage change to e.g. 17% must be entered as *1.17	**size *2 font sans** a
	Font attributes	The command to change the character color; first the color name (blank, white, cyna, magenta, red, blue, green and	**color green** abc

Symbol Presented in Formula	Type	Description	Example of text formula instruction
		yellow) is entered, then the characters to be changed are entered.	

In addition to easy generation of a formula, the present invention includes an easy way to edit a data object like a mathematical formula. The object is entered by, e.g., a mouse click, on the object, and then is reconverted into the text formula instruction containing the text instruction symbols. The user edits the object by editing the text formula instruction, selects the edited text formula instruction again, and converts the same again into a data object, as described above. The editing operation can thus be carried out easily without entering a special tool like a formula editor.

Further, those of skill in the art will appreciate that while memory 311C is illustrated as one unit that can include both volatile memory and non-volatile memory, in most computer systems, memory 311C is implemented as a plurality of memory units. In more general terms, method 205 is stored in a computer readable medium, and when method 205 is loaded from the computer readable medium into a memory of a device, the device is configured to be a special purpose machine that executes method 205. Alternatively, the application used to execute method 220, e.g., application 319, may be stored in one computer readable

medium, and method 230 stored in another computer readable medium.

Also, herein, a computer program product comprises a medium configured to store or transport computer readable code for method 205, method 220, and/or method 230 or in which computer readable code for method 205, method 220, and/or method 230 is stored. Some examples of computer program products are CD-ROM discs, ROM cards, floppy discs, magnetic tapes, computer hard drives, servers on a network and signals transmitted over a network representing computer readable program code.

As illustrated in Figure 3A, this storage medium may belong to computer system 300C itself. However, the storage medium also may be removed from computer system 300C. For example, method 205 may be stored in either memory 311A or 311B that is physically located in a location different from processor 312C. The only requirement is that processor 312C is coupled to memory. This could be accomplished in a client-server system, e.g. system 300C is the client and system 300B is the server, or alternatively via a connection to another computer via modems and analog lines, or digital interfaces and a digital carrier line.

For example, memory 311C could be in a World Wide Web portal, while the display unit and processor are in a personal digital assistant (PDA), or a wireless telephone, for example, system 300A. Conversely, the display unit and at least one of the input devices could be in a client computer, a wireless telephone, or a PDA, while the memory and processor are part of a server computer on a wide area network, a local area network, or the Internet. In this paragraph, method 205 that includes the application used to perform method 220, as well as method 230 was

considered. However, those of skill in the art will appreciate that a similar description can be made for only method 220 and for only method 230. Accordingly, this description and that which follows is not repeated for each of the possible combinations and permutations for using and storing methods 220 and 230.

More specifically, computer system 300C, in one embodiment, can be a portable computer, a workstation, a two-way pager, a cellular telephone, a digital wireless telephone, a personal digital assistant, a server computer, an Internet appliance, or any other device that includes the components shown and that can execute method 205. Similarly, in another embodiment, computer system 300C can be comprised of multiple different computers, wireless devices, cellular telephones, digital telephones, two-way pagers, or personal digital assistants, server computers, or any desired combination of these devices that are interconnected to perform, method 205 as described herein. See, for example, Figure 3A.

Accordingly, a computer memory refers to a volatile memory, a non-volatile memory, or a combination of the two in any one of these devices. Similarly, a computer input unit and a display unit refers to the features providing the required functionality to input the information described herein, and to display the information described herein, respectively, in any one of the aforementioned or equivalent devices.

In view of this disclosure, method 230 and method 220 can be implemented in a wide variety of computer system configurations. In addition, method 205 could be stored as different modules in memories of different devices. For example, method 205 could initially be stored in a server computer, and

then as necessary, a module of method 205 could be transferred to a client device and executed on the client device. Consequently, part of method 205 would be executed on the server processor, and another part of method 205 would be executed on the client device. In view of this disclosure, those of skill in the art can implement the invention of a wide-variety of physical hardware configurations using an operating system and computer programming language of interest to the user.

In yet another embodiment illustrated in Figure 3B, method 205 is stored in memory 311B of system 300B. Stored method 205 is transferred, over network 315 to memory 311C in system 300C. In this embodiment, network interfaces 330B and 330C can be analog modems, digital modems, or a network interface card. If modems are used, network 315 includes a communications network, and method 205 is downloaded via the communications network.

While the invention has been particularly shown with reference to a preferred embodiment thereof, it will be understood by those skilled in the art that various other changes in the form and details may be made therein without departing from the spirit and scope of the invention.